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Vol. IX LANCASTER, PA., MARCH, 1919 No. 7

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TABLE OF CONTENTS.

Membership and Duties of Committees of the Society 247
Officers 1918–19 250
Institutional Members Elected since last year book was published .. 251
Individual Members elected since last year book was published 251
Changes in addresses and titles since last year book was published .. 254
Names to be removed from year book due to deaths and resignations. 259
Deceased Members 259
Book Review 260
College Notes 260
Army Vocational Training. By C. R. Dooley 263
Some Unconsidered Factors. By Sada A. Harbarger 278
Bachelors of Science or Skill? By W. H. Rayner 282

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WINSLOW, A. M., Dept. of Mechanical Engineering, University of Washington, Seattle, Wash.

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WOHLENBERG, W. J., Assitant Professor of Mechanical Engineering Sheffield Scientific School, Yale University, New Haven, Conn.

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YOUNG, L. E., Room 400, Union Electric Building, St. Louis, Mo.

NAMES TO BE REMOVED FROM YEAR BOOK DUE TO DEATHS AND RESIGNATIONS.

AYRES, BROWN
BAEBENROTH, A. C.
BAILEY, A. R.
BANKSON, E. E.
BELL, J. M.
BELLIS, A. E.
BETTS, PHILANDER
BIEGLER, P. S.
BRATTON, W. A.
BUSH, VANNEVAR
CAJORI, FLORIAN
CHRISTIAN, J. W.
DEAN, STANLEY
DENNISON, B. C.
DUFF, C. M.
EDWARDS, W. W.
ELL, CARL S.
EMSWILER, J. E.
FARWELL, S. P.
FERGUSON, O. J.
FISHER, GEO. H.
FRANKFORTER, G. B.
GARVER, J. D.
GATES, A. O.
GEARHART, W. S.
GEORGE, R. D.
GROETZINGER, CARL A.
HASTINGS, H. B.
HENLEY, W. W.
HENSHALL, P. P.
HERSCHEL, W. H.
HOOPER, W. L.
HUND, AUGUST
JACKSON, JOHN PRICE
JONES, G. R.
KENT, WILLIAM
KNAPP, W. A.
MCALISTER, E. H.
MCLEOD, D. F.
MCNAIR, G. B.
MARBURG, EDGAR
MASON, A. J.
MISER, W. L.
MOORE, F. C.
MORITZ, R. E.
OGLESBY, N. E.
PARMELEE, H. C.
POPE, WILLARD
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RICHARDSON, CLIFFORD
RIDOUT, JOHN
RODGERS, L. J.
ROOT, J. E.
RUSSELL, L. K.
SAWYER, A. R.
SCHILDHAUER, EDWARD
SMITH, R. J.
STEINMETZ, C. P.
STEVENS, J. FLOYD
STOUT, O. V. P.
SWEETSER, E. O.
TAYLOR, I. I.
TOUCEDA, E. A.
TRUMMELL, M. F.
VON ENDE, C. L.
WARNER, F. M.
WHEATLEY, G. S.
WURTS, A. J.

DECEASED MEMBERS.

Name.	Year of Election.	Date of Death.
Ayres, Brown	1898	
Christian, J. W.	1914	February 24, 1918.
Dean, Stanley	1917	October, 1918.
Garver, J. D.	1915	February 11, 1919.
Hooper, W. L.	1907	October 3, 1918.
Jones, G. R.	1914	December 22, 1918.
Kent, William	1894	November 1, 1918.
Marburg, Edgar	1894	June 27, 1918.
Parmelee, H. C.	1916	
Stevens, J. Floyd	1913	October, 1918.
Trummell, M. F.	1915	August 4, 1918.

BOOK REVIEW.

Sound, Light, Electricity and Magnetism. By WILLIAM BALLANTYNE ANDERSON, Ph.D., Professor of Physics, Oregon State College. First edition. xiii + 337–794 pages. McGraw-Hill Book Company, Inc., 1919. Price, $2.00 net.

The present volume is the latter part of a complete text book, the Mechanics and Heat part of which has already been published. The two books will be combined thus giving a complete text in one volume.

The author has presented his subject in an interesting way, yet in such a manner that all the underlying principles of this great subject are clearly brought out. The student is lead from the simple easily understood portions of the subject by short intellectual steps to the more involved relations, accompanied on his way by the mathematical deductions and relations, so that at the end of his journey he has a complete conception of physics.

The book is modern in every respect, the chapters on Radioactivity and Radiotelegraphy containing much matter that has not heretofore appeared in books of this nature.

In the reviewer's opinion this book will prove very acceptable to those who are looking for a clear, direct, and quantitative method of teaching physics. G. I. M.

COLLEGE NOTES.

Kansas State Agricultural College.—Dr. William Marion Jardine was inaugurated into the presidency of the Kansas State Agricultural College, Manhattan, Kans., on Tuesday, February 4.

In his inaugural address Dr. Jardine laid down a program embodying a combination of industrial and liberal training as the most important step in future education. He urged the adoption of world-wide principles of education as a preventive of wars and suggested an educational commission of advice in any league of nations that should be established.

Dr. Raymond Allen Pearson, president of the Iowa State College, who was the principal speaker from outside the state, emphasized the importance of moral, and physical, as well as intellectual training. He traced the history of agricultural and industrial education from its beginnings in the United States to the present time. He characterized as inspired the passage of the Morrill Act, which established land-grant colleges in the various states.

Dr. Jardine, the new president of the Kansas State Agricultural College, was born on a ranch in Idaho in 1879. He holds the degree of bachelor of science in agriculture from the Utah Agricultural College and of doctor of laws from Campbell College. He has been a member of the faculty of the Kansas State Agricultural College since 1910, when he came to the institution as professor of agronomy. Prior to his election to the presidency he had served for several years as dean of agriculture and director of the agricultural experiment station.

He is a former president of the American Society of Agronomy, of the International Farm Congress, and of other organizations. He is one of the best known authorities on dry farming, having been at one time specialist in this subject for the United States Department of Agriculture, and being author of many bulletins and special articles on this subject, published in the United States and in foreign countries.

Lafayette College.—Signal recognition of the work of Dr. Edward Hart, professor of chemistry at Lafayette College for the past forty years, has been paid in the establishment recently in his honor at Lafayette of a $10,000 fellowship, to be known as the Edward Hart Fellowship in Chemistry. This fellowship, yielding $500 a year, is open to all students of chemistry holding the bachelor's degree, and, at the suggestion of the National Research Council, the holder is to do research work in problems connected with viscous and plastic flow—practically a virgin field, and of vast importance to industry and pure science. The recipient of the fellowship is expected to spend the academic year in residence, and the work done may be counted towards meeting the requirements of a graduate degree.

The project of the fellowship was conceived about a year ago at a dinner of the New York City alumni association. The fund has now been completed through the generosity of a comparatively small group of Lafayette men. The committee under whose auspices the fellowship was endowed consists of George P. Adamson, chairman, George Auchy, Gideon Boericke, Hugh E. Meyers, Matthew Scammel, Gustave Wiedenmayer and Eugene C. Bingham, secretary.

Professor Hart, whose services have been thus splendidly recognized, is widely known for his services to the science of chemistry. He is the inventor of some notable chemical and industrial apparatuses, a widely known writer of chemical text-books and editor of chemical journals, a publisher of chemical books, a manufacturer of pure chemicals, an investigator of practical chemical problems, an excellent teacher and a public-spirited citizen. The men whose generosity has made the fellowship possible are practically all former students of Professor Hart, who contribute in a large measure their achievements in life to his instruction and inspiration.

ARMY VOCATIONAL TRAINING.

BY C. R. DOOLEY,
Educational Director.

The Committee on Education and Special Training was appointed in February, 1918. Early in the spring plans were developed to train 90,000 men for the service who would meet certain definite specifications. These specifications were: first, that the men must be soldiers, disciplined to prompt and complete obedience and accustomed to the routine of army life; second, these men must be skilled in some trade specifically needed in the army; third, these men must have

FIG. 1. A Class in Horseshoeing, Cornell Detachment.

that originality and initiative which would prompt them as soldiers to use the tools and materials at hand in meeting emergencies. In other words, the problem was not one of

turning out an aggregation of mechanics but rather an organization of soldiers possessing special trade ability.

The length of the course decided upon for this experiment was two months, and it was proposed to train the 90,000 men between the fifteenth of April and the fifteenth of November. I use the word "experiment" advisedly for the job was absolutely new and no one was in position to prophesy to what degree it would succeed.

A plan of organization was adopted which would largely decentralize inspection and administration. The committee,

FIG. 2.

the advisory board, the executive military officers and the vocational director remained in Washington in charge of the planning. At first the United States was divided into ten districts, each with its field military officer and district vocational director in full charge of administrative details. Later the districts were increased to twelve and a central office for

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each district was established as a headquarters for the field military officers, district vocational directors and the field representatives in charge of business relations. Through this plan of organization, responsible administrative officers were constantly traveling in all sections of the country approving, establishing and inspecting units. The results of the work of the field organization were wired to Washington each night, and the field organization was kept informed by telegraph of the changing needs as to numbers of men required in each trade and changes in specifications of the soldiers duties in the various trades taught.

Possibly some explanation is required of the fact that as

FIG. 3.

the war progressed the type of men required in many of the trades changed as well as the number of men in each trade. This was partly due to the circumstance that the committee was called upon to supply men whom the army could not get through the draft boards and partly due to the continual

change in the character of the available supply of men obtainable from the Provost Marshal General's office. Changes in equipment and plans of organization of army corps and changes in methods of warfare were constantly producing changes in the trade specifications. It was found necessary in the summer to establish a subdivision of the organization at Washington with representatives from each of the corps

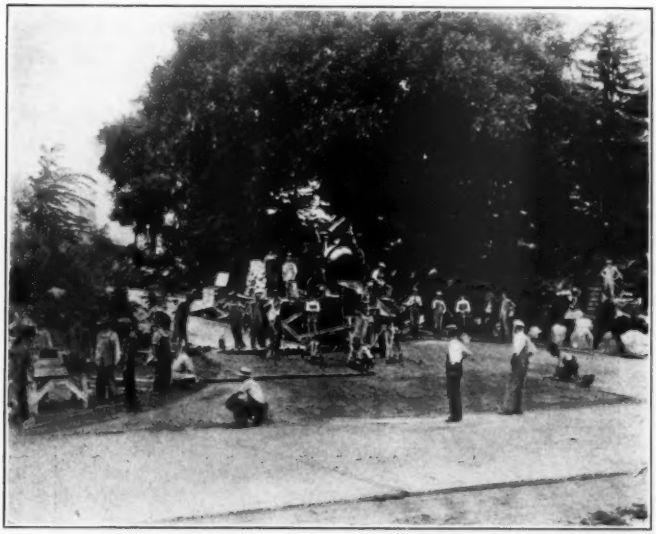


FIG. 4.

charged with the special duty of keeping the committee informed of the requirements in numbers and the changes in specifications in the various trades.

The daily program in each of the schools was alike in that it had three hours a day of military training and six hours a day of trade instruction. The military instruction included infantry drill, military courtesy, inspection and general military subjects, tending not only to break in green men but to

develop habits of promptness, decision and order and to establish a company spirit in place of the normal American individual spirit.

To a remarkable degree, the military team work spirit, the discipline, and courtesy influenced the atmosphere of the shops and class rooms and greatly strengthened the vocational interest of the soldiers. So great was this influence in fact

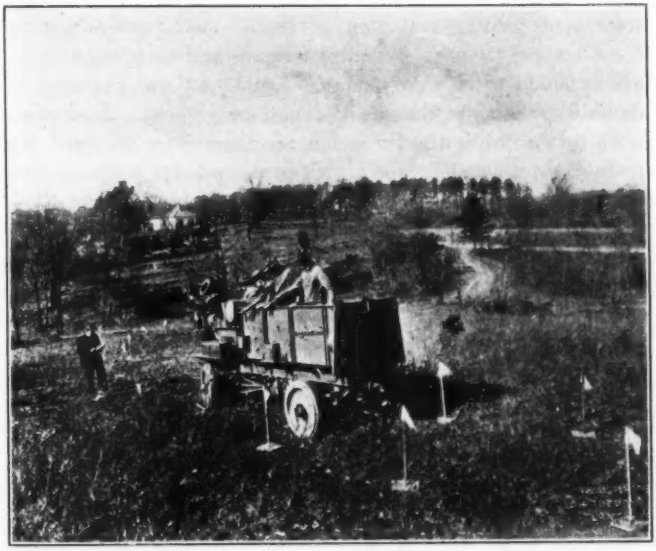


FIG. 5.

that I doubt if satisfactory vocational work could have been done without the accompanying military training. Each man seemed eager to find the place in the war team to which he was to be assigned and eagerly sought to train himself to play the game according to the rules. The enthusiastic leadership of the military officers contributed greatly to this war spirit.

As a preliminary to the trade training an attempt was made to sort the men and assign them with due regard to their experience and natural aptitude. When it was possible to assign a man to a trade in which he had experience and for which he had natural aptitude, the job of training him was easy. If a man has made a success at a given line of work the chances are favorable for giving him further special training along the same lines. On the other hand, the circumstances of youth have often prevented men from following their natural talents. When experience and natural aptitude are opposed, the best of judgment and tact was required to determine the right classification and assignment. Such cases were by no means the exception for there were assigned for training occasional details which contained not a single man with experience in any of the trades to be taught, and what was still more discouraging in the early days to the supervisors, the details contained few men with any apparent natural aptitude for any of the trades.

I well remember a long distance telephone call from one of our schools, during which the supervisor with tears in his voice reported that he had just received 400 men to train as blacksmiths, carpenters, electrical workers and machinists, who were classified as to experience as laborers, garment workers, teamsters and 'longshoremen, but who in the private opinion of the supervisor, were chiefly loafers, toughs and ne'er-do-wells. Certainly this detail was made up of men who had never been in an industrial shop and had never handled a shop tool or a foot rule. The prospect for their successful training seemed hopeless to the supervisor.

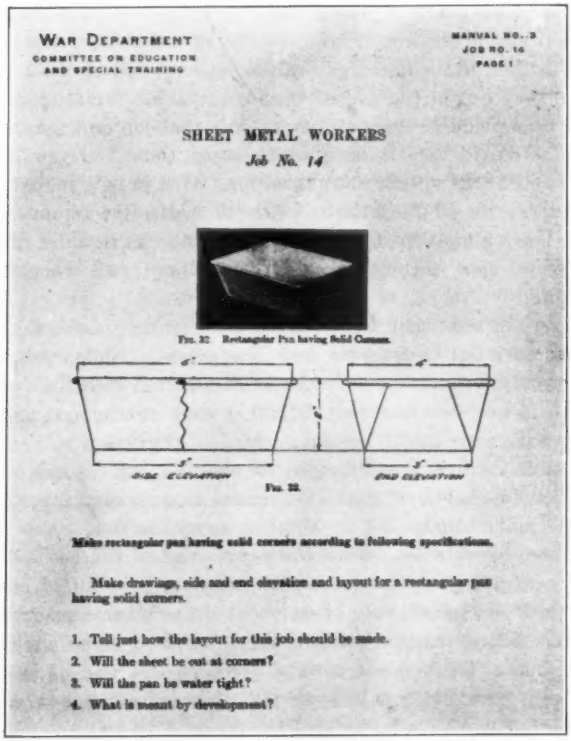
After some persuasion this supervisor assigned his motley group to classes and started the job. It was only a few days before signs of a remarkable change began to appear in these men. With the aid of an able commanding officer and his lieutenants, admirable military discipline was quickly brought to the aid of efficient shop instruction with the result that 360 "fighting mechanics" were delivered to the army on schedule.

Of this number, 26 were blacksmiths and not one had ever struck a piece of iron while it was hot previous to joining the school. So enthusiastic were the instructors over their accomplishment with these men that at the end of six weeks, they reported them as having made greater progress than the regular students in a year's time. You may be sure that we were proud of these men; you may be sure that their teachers, and in fact, the whole organization, were proud of these men when they left at the end of their eight weeks training. The men took pride in their ability to do a real job and they took satisfaction in the training which made them feel that they belonged to the military organization. One must live through an experience of this kind in order to realize the remarkable, may I say almost miraculous, change that was brought about in these men through combined military and vocational training.

I am not sure that I have made sufficiently prominent one of the essential facts in my last illustration. Not merely did we undertake to train all of these ill-assorted men, but practically a hundred per cent. of them were turned out as soldiers with some useful special aptitudes. Contrary to civilian practice, there was no thought of weeding out the less skillful, but instead each man was trained to do something which would make him useful to the army organization.

If you were to ask one of the supervisors of the 155 schools that coöperated in this vocational training, they would multiply instances indefinitely of men without previous background of experience, learning within the prescribed eight weeks to turn out a finished commercial job in some one of the 71 trades. Dean Bishop likes to tell of a farmer boy who reported to the University of Pittsburgh with but a common school education. He was assigned to the sheet metal shop and within six weeks he was turning out stove pipe elbows, baking pans, mess tins, and a variety of other commercial articles from patterns which the soldier himself developed by sound principles of descriptive geometry. He had been re-

quired to make a drawing and a stretchout pattern for each job which he undertook and through this, the principles of projection and intersection were learned in a manner which made them available for practical application; learned in this



WAR DEPARTMENT
COMMITTEE ON EDUCATION
AND SPECIAL TRAINING

MANUAL NO. 3
JOB NO. 14
PAGE 1

SHEET METAL WORKERS

Job No. 14

FIG. 32. Rectangular Pan having Solid Corners.

FIG. 33.

Make rectangular pan having solid corners according to following specifications.

Make drawings, side and end elevation and layout for a rectangular pan having solid corners.

1. Tell just how the layout for this job should be made.
2. Will the sheet be cut at corners?
3. Will the pan be water tight?
4. What is meant by development?

FIG. 6.

way these principles became something more than memorized facts. There is something inspiring about the method and atmosphere of this work which gripped this man and

hundreds of others like him and gave them all an enthusiasm for some form of industrial work which promises to survive the war. Three men in the pattern-making course at the Carnegie Institute of Technology, who had formerly been bank clerks, are reported by Dean Connelly to declare most emphatically that they will never leave the wood-working industry.

The method of instruction which was adopted by all of our schools can best briefly be described by saying that the men *learned by doing.* If you will notice the first slide, you will see that a class of men in Cornell are learning to shoe horses; they are making the shoes and they have the horses at hand. In the right-hand corner, you will see a husky looking private putting the shoes where they belong. In slide 2, we have a picture of the miners at the Michigan School of Mines learning the game by working underground under the direction of an experienced mine boss. The men in this school were divided into two platoons, which alternated daily in taking instruction in underground work and in above ground instruction in military subjects and in classroom discussion of mine practice. Slide 3 shows telephone linemen splicing a cable under field conditions in Idaho. Slide 4 shows the soldiers of the training unit at Mooseheart putting in a section of concrete road. Slide 5 shows one of the devices used in testing truck drivers as to the accuracy with which they handled a vehicle. The problem here was to drive between flags without knocking any down.

This method of learning by doing seems to harmonize with something that is fundamental in human nature. The creative instinct seems to be a more common possession of mankind than is generally supposed. Certainly the accomplishment of practical results without help is one of the most stimulating of human experiences. With this creative instinct aroused, a man normally becomes hungry for more accurate and deeper scientific information in order that his creation may be more perfect. He thereafter begins to teach

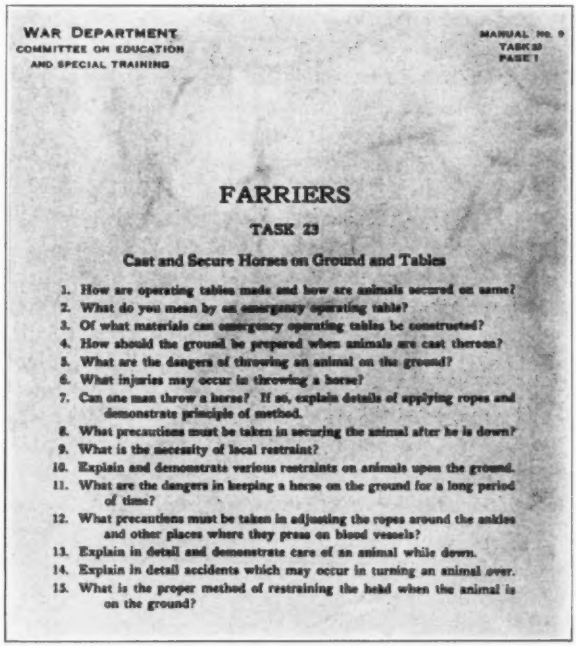
himself and the instructor gradually finds himself functioning as a means of the final checking of results.

In order to facilitate the teaching of soldiers by doing practical jobs, the division of our Washington organization, responsible for methods of instruction undertook to develop a series of manuals which suggested a course of instruction for each trade. Each course was made up of jobs graduated in difficulty and progressively calling for additional trade knowledge and skill. Slide 6 illustrates a sheet metal job

FIG. 7.

sheet. You will notice that this starts out with a brief command as to the article to be made. It shows a photograph and a sketch of this article and directs that a drawing and layout be made in advance of undertaking the actual construction of the article. These directions are followed by questions, the first of which are designed to aid the men to think through the essential steps in performing the task. The

later questions are intended to insure that he accumulates all the information and knowledge of principles which should properly be associated with doing the particular task. The men are expected to find out the answers to these questions during the process of doing the job. The instructor is not so much a source of information as a court of last appeal, who



WAR DEPARTMENT
COMMITTEE ON EDUCATION
AND SPECIAL TRAINING

MANUAL No. 9
TASK 23
PAGE 1

FARRIERS

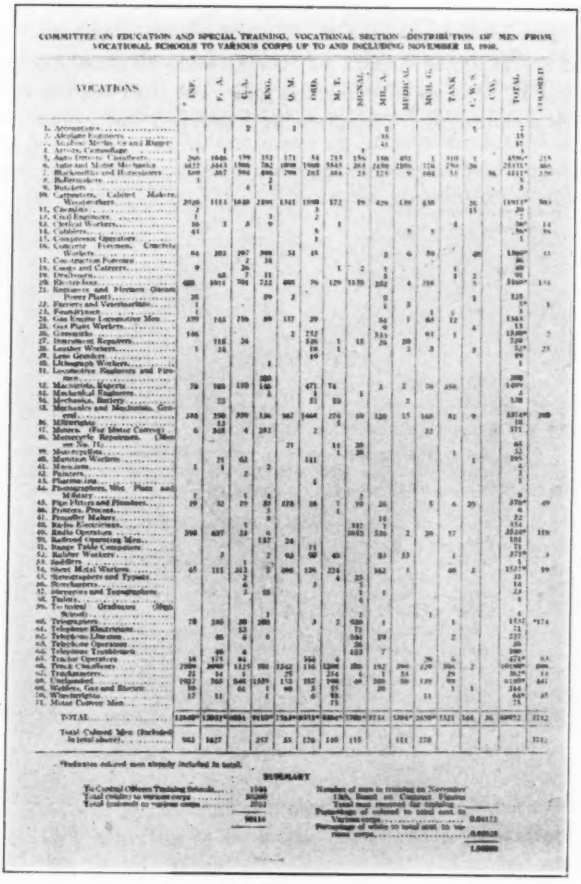
TASK 23

Cast and Secure Horses on Ground and Tables

1. How are operating tables made and how are animals secured on same?
2. What do you mean by an emergency operating table?
3. Of what materials can emergency operating tables be constructed?
4. How should the ground be prepared when animals are cast thereon?
5. What are the dangers of throwing an animal on the ground?
6. What injuries may occur in throwing a horse?
7. Can one man throw a horse? If so, explain details of applying ropes and demonstrate principle of method.
8. What precautions must be taken in securing the animal after he is down?
9. What is the necessity of local restraint?
10. Explain and demonstrate various restraints on animals upon the ground.
11. What are the dangers in keeping a horse on the ground for a long period of time?
12. What precautions must be taken in adjusting the ropes around the ankles and other places where they press on blood vessels?
13. Explain in detail and demonstrate care of an animal while down.
14. Explain in detail accidents which may occur in turning an animal over.
15. What is the proper method of restraining the head when the animal is on the ground?

FIG. 8.

can settle discussions, rectify mistakes and prevent delays through indecision. One of my associates illustrates the philosophy of this method from poultry lore by saying that it is better to feed scratch food than whole corn. Whether or not



COMMITTEE ON EDUCATION AND SPECIAL TRAINING. VOCATIONAL SECTION. DISTRIBUTION OF MEN FROM VOCATIONAL SCHOOLS TO VARIOUS CORPS UP TO AND INCLUDING NOVEMBER 15, 1918.

VOCATIONS	INF.	F. A.	C. A.	ENG.	G. M.	CHEM.	M. R.	SIGNAL	AIR. S.	MEDICAL	M. R. C.	TANK	C. W. S.	CAV.	TOTAL	TRAINED
1. Accountants			2		1				6				1		7	
2. Aeroplane Engineers									16						16	
3. Aeroplane Motor and Engine Mechanics									41						41	
4. Artists, Camouflage	1	1						1							1	
5. Auto Drivers, Chauffeurs	260	1646	139	152	171	54	215	156	146	491	1	110	1		4596*	215
6. Auto and Motor Mechanics	4452	4443	1986	782	1898	1960	5845	203	2450	2395	776	280	36		28111*	660
7. Blacksmiths and Horseshoers	508	267	504	496	799	283	664	24	324	9	1084	51		86	4821*	150
8. Boilermakers	5			2											5	
9. Buglers			4	1											5	
10. Carpenters, Cabinet Makers, Woodworkers	2026	1111	1443	2496	1341	1998	172	19	429	139	430		26		11911*	301
11. Chemists	1			3		3							15		30	
12. Civil Engineers	1					2									3	
13. Clerical Workers	16	3	5	9		5	1			5	5	6			50*	14
14. Cobblers	41					6									56*	24
15. Competrese Operators						1									1	
16. Concrete Foremen, Concrete Workers	84	203	397	908	54	45			2	6	30		40		1800*	61
17. Construction Foremen			2	24											26	
18. Cooks and Caterers	9		20	7			1	2	1			1			40	
19. Draftsmen		68	7	11					2			2	2		92	
20. Electricians	680	1011	701	722	405	76	129	1159	262	6	216	2	5		5166*	176
21. Engineers and Firemen (Steam Power Plant)	35			99	2				2				2		140	
22. Farriers and Veterinarians	1								1	2					4	1
23. Foundrymen	1										1	1			3	
24. Gas Engine Locomotive Men	339	703	750	89	137	39			84	1	64	12			1544	
25. Gas Plant Workers									9				4		13	
26. Gunsmiths	106				2	732			343		91	1			1275*	7
27. Instrument Repairers		115	36			326	1	15	28	20					726	
28. Leather Workers	1	26				19	1			3	3		2		55*	25
29. Lens Grinders						99									99	
30. Lithograph Workers				1											1	
31. Locomotive Engineers and Firemen				205											205	
32. Machinists, Reports	79	103	110	146		471	74	1	5	2	26	456			1499*	
33. Mechanical Engineers				5		1									6	
34. Mechanics, Battery		73				81	10			2					166	
35. Mechanics and Mechanics, General	202	250	339	136	367	1466	276	10	120	15	160	82	9		3357*	205
36. Milwrights		12					2								10	
37. Motors (For Motor Convoy)	6	348	4	282		2					22				371	
38. Motorcycle Repairmen (See sec. 16)					21		11	20							65	
39. Motorcyclists							1	30				1			32	
40. Munition Workers		71	61			141							1		197	
41. Musicians	1	1		3											5	
42. Painters			2			1									3	
43. Pharmacists																
44. Photographers, Mot. Plate and Motion	1		1	6					2						9	
45. Pipe Fitters and Plumbers	19	32	19	37	178	18	7	10	35		5	6	39		370*	49
46. Printers, Pressmen				5			1								6	
47. Propeller Makers				3					19						22	
48. Radio Electricians			1					152	1						154	
49. Radio Operators	390	427	23	5				1053	535	2	20	57			2520*	110
50. Railroad Operating Men				187	24										211	
51. Range Table Computers						21									21	
52. Rubber Workers		2		7	93	90	40		31	13		1			277*	3
53. Saddlers																
54. Sheet Metal Workers	65	115	163	3	106	126	224		162	1		68	3		1537*	99
55. Stenographers and Typists			3				4	35							39	
56. Storekeepers			6			2		3							14	
57. Surveyors and Topographers			2	23				1	1						28	
58. Tailors								6							6	
59. To-tural Graduates (Non-School)			1					1								
60. Telegraphers	78	386	20	388		3	2	920	1			1			1532	974
61. Telephone Electricians			13					72							71	
62. Telephone Linemen		68	6	6				1041	19			2			227	
63. Telephone Operators								26							26	
64. Telephone Truckdrivers		66	4					1017	7						1094	
65. Tractor Operators	14	175	84			166	4	35			76	5			475*	8
66. Truck Chauffeurs	7709	3090	1125	981	1242	116	1208	181	192	200	170	1026	2		16500*	208
67. Truckmasters	21	54	1		25		254	4	1	14		29			382*	10
68. Undesignated	1982	360	846	1459	153	197	198	60	305	59	139	99			6109*	641
69. Welders, Gas and Electric	10		64	1	60	5	15		20			1	1		164	
70. Wheelwrights	17	11		1		6	93				11				140	45
71. Motor Convoy Men							75								75	
TOTAL	17040*	13021*	9034	9110*	7849	9513*	8067	7308*	3744	3304*	2670*	2321	344	86	86972	3742
Total Colored Men (Included in total above)	963	1627		257	55	170	146	115		111	270					3742

*Federation colored men already included in total.

SUMMARY

To Central Officers Training Schools	1946	Number of men in training on November 15th, based on Contract Figures
Total (white) to various corps	86280	Total men returned for training
Total (colored) to various corps	3742	Percentage of colored to total sent to Various corps
	90116	Percentage of white to total sent to various corps

0.04173

0.95827

1.00000

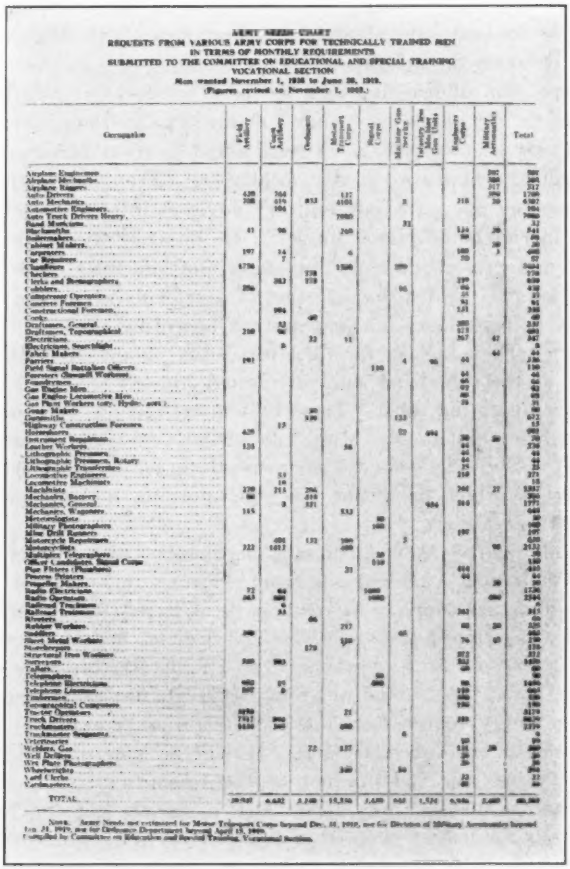
FIG. 9.

the illustration is good, it is certainly much better that the instructor should judge the correctness of the information which the men have obtained by their own efforts than that he give them the information.

This plan of teaching men by doing worked out well in a great variety of trades. Slide 7 shows some farriers in training. By the way, when we were asked to train farriers, we all added a new word to our vocabulary. After many wrong guesses on our part, our military advisors informed us that "A farrier is an animal nurse." He does not diagnose disease and prescribe for it, but treats and generally cares for sick animals, under the direction of a veterinarian. The soldiers in this class had prepared an operating table of corn husks. They had so fastened restraints upon "Mr. Mule" that at the signal, he suddenly found himself stretched out on the operating table. These fellows are having the time of their life making "Mr. Mule" do what he evidently does not enjoy. Slide 8 shows the corresponding job sheet with the questions which bring out the high spots in the problem of throwing animals.

Slide 9 gives the statistics of the number of men trained and delivered to the various army corps up to November 13. This slide also emphasizes the variety of trades for which the men were trained and the diversified demand for the product of our schools in the various corps. Slide 10 illustrates the diversity of the demand by giving the army needs in terms of the monthly requirements in each trade as reported to the committee on November first. It will be noticed that the army needs for the product of the committee schools had reached a demand for 60,000 men a month and the total requests for trained men to be delivered by the committee up to July 1, 1919, had reached the total figure of 760,000 men.

Mere numbers of course do not tell the whole story. Yet there is one fact about the numbers trained in our vocational schools which meant a great deal to our military program. The soldiers in training in our schools represented numbers



ARMY NEEDS CHART

REQUESTS FROM VARIOUS ARMY CORPS FOR TECHNICALLY TRAINED MEN IN TERMS OF MONTHLY REQUIREMENTS

SUBMITTED TO THE COMMITTEE ON EDUCATIONAL AND SPECIAL TRAINING VOCATIONAL SECTION

Men wanted November 1, 1918 to June 30, 1919.

(Figures revised to November 1, 1918.)

Occupation	Field Artillery	Coast Artillery	Ordnance	United States Engineers	Signal Corps	Machine Gun Service	Infantry, Inc. Guards, Tanks	Engineers Corps	Military Aeronautics	Total
Airplane Engineers									200	200
Airplane Mechanics									300	300
Airplane Riggers									217	217
Auto Drivers	420	704	853	137				216	196	1700
Auto Mechanics	208	679		4101		3			30	6987
Automotive Engineers		104								104
Auto Truck Drivers Heavy				7000						7000
Band Musicians						32				32
Blacksmiths	61	96		260				120	20	561
Boilermakers								90		90
Cabinet Makers	197	14		6				100	30	347
Carpenters		7						50		57
Car Repairers	1750			1500		200				3450
Chauffeurs			728							728
Checkers			778							778
Clerks and Stenographers	206	383				96		197		882
Cobblers								65		65
Compressor Operators								61		61
Concrete Formers								61		61
Constructional Foremen		104						131		235
Cooks		62	60							122
Draftsmen, General		62						208		270
Draftsmen, Topographical	260	60						115		435
Electricians		9	22	11				367	67	476
Electricians, Searchlight									44	44
Fabric Makers										
Farriers	391					4	96	66		557
Field Signal Battalion Officers					130					130
Firemen (Small) Workmen								65		65
Foundrymen								65		65
Gas Engine Men								65		65
Gas Engine Locomotive Men								65		65
Gas Plant Workers (city, Hydr. and)								65		65
Gauge Makers										
Gunsmiths			30							30
Highway Construction Foremen			100			133				233
Horseshoers						33				33
Instrument Repairmen	420	12					494			926
Leather Workers	135			56				130	30	351
Lithographic Pressers								130		130
Lithographic Pressers, Rotary								130		130
Lithographic Transferrers								130		130
Locomotive Engineers		11						260		271
Locomotive Machinists		10								10
Machinists	220	213	256					260	27	1007
Machinists, Battery	80		416							496
Mechanics, General		9	321				936	260		1526
Mechanics, Wagoners	165			532						697
Meteorologists					30					30
Military Photographers					100					100
Mine Drill Runners								195		195
Motorcycle Repairmen		104	132	390		3				629
Motorcyclists	322	1013		600					98	2033
Multiplex Telegraphers					30					30
Officer Candidates, Signal Corps					130					130
Pipe Fitters (Phosphate)				31				416		447
Process Printers								65		65
Propeller Makers	22								30	52
Radio Electricians	22	84			1000					1106
Radio Operators	663	260			1000				600	2523
Railroad Trackmen		2-6								26
Railroad Trainmen		13						260		273
Riveters			66							66
Rubber Workers				297				65	30	392
Saddlers	390					65				455
Sheet Metal Workers				130				78	65	273
Shipwrights			370							370
Structural Iron Workers								832		832
Surveyors	260	260						832		1352
Tailors								65		65
Telegraphers					30					30
Telephone Electricians	650	91			600			780		2121
Telephone Linemen	507	9						780		1296
Timbermen								780		780
Topographical Computers								780		780
Tractor Operators	2470			21						2491
Truck Drivers	7917	832						780		9529
Trackmasters	1430	260		650						2340
Trackmaster Sergeants						6				6
Viticulturists								780		780
Welders, Gas			22	137					30	189
Well Drillers								780		780
Wig Plate Photographers								780		780
Wheelwrights				260		30				290
Yard Clerks								832		832
Yardmasters								780		780
TOTAL	20,910	6,682	5,240	15,536	3,489	665	1,524	9,984	2,660	66,690

NOTE.—Army Needs not estimated for Motor Transport Corps beyond Dec. 31, 1918, nor for Division of Military Aeronautics beyond Jan. 31, 1919, nor for Ordnance Department beyond April 15, 1919.

Compiled by Committee on Education and Special Training, Vocational Section.

FIG. 10.

under arms in excess of the capacity of the cantonments. It in this way came about that, as a result of our training program, 70,000 trained soldier mechanics were sent to France in excess of the number which could have otherwise been sent.

I have come here today to submit to you the question as to whether there may not be a lesson in this army experiment to guide us in the reconstruction vocational education program which this country must not fail to undertake. I do not know what machinery will be set up to bring together groups of men with strong vocational motives for post-war training. Certainly, even with military instruction, it would be difficult to exactly reproduce the war spirit which animated our "fighting mechanics." Nevertheless, I cannot escape the conviction that whatever limiting conditions may surround vocational instruction in this country in the future there will still be something of value to be learned from the success of these two months vocational courses. For those who would study the record of this experiment further, there will presently be available a final report and a limited supply of copies of the instruction material.

SOME UNCONSIDERED FACTORS.

BY S. A. HARBARGER,
New York, N. Y.

The most important considerations which enter into any discussion of the teaching of English literature and composition to students in engineering colleges are three: (1) The professional training of the instructor in his subject; (2) the personality of the instructor; (3) the coöperation of the engineering college.

That the instructor should be well versed in his subject seems self-evident. Some comment in passing, however, is apropos, since his use and interpretation of his professional knowledge are significant. Indeed, upon his adaptation of his specialized information to the peculiar needs of his students depends his success. That is, he must acknowledge that there are other things of real value in the world beside English which can hold and stimulate the minds of eager, thoughtful persons to high endeavor. He is tolerant and sympathetic, therefore, toward the attitude of the general reader. He never loses sight of the place that literature and writing must always occupy in the mind of every one who has not made the study of them a profession—as a means of expressing an absorbing idea; as a means of escape when the serious business of life becomes intolerable and routine threatens to madden; as recreation. To meet these needs of the layman reader, the English instructor adapts his choicest wares in expression and thought.

Next, he who would teach English to the engineering student must be a person with broad sympathies, and a keen understanding of the characteristics of this particular type of student. To the casual observer the engineer is generally no

more than an earth-bound being whose spirit is easily stirred only by the most crass materialism. No one will deny that he is practical; that he demands tangible results from every project upon which he expends his thought and energy; that he is shrewd; that he is definite. Yet he has also some characteristics to which English literature and composition may make a powerful appeal and which may be utilized by the English instructor.

First of all, he has an eagerness, an enthusiasm for his own profession which may easily be made to include more than its most apparent and narrowly technical phases. Second, he has imagination and idealism. He is always dreaming of his Golden Age, though he knows of no way but the materialistic one whereby it may be realized. Tactfully guided, he is willing, however, to hear and to think over the dreams and visions of the great writers. In other words, if the teacher of English understands; if he has lived and experienced life within and without academic circles; if he centers his English teaching around the engineer's burning interests and leads out from them, he can stimulate the highest appreciation of the best that is thought and said in the world, in the mind of this practical student.

Again, to teach engineers successfully the English instructor should come to his work with some innate interest in engineering. This statement does not mean that the instructor must have at his tongue's end all the scientific nomenclature of the engineering profession or be able to speak authoritatively upon all its intricacies. It simply means that he must take sincere enjoyment in the broad aspects of the various projects in which the engineer takes delight and upon which he lavishes his attention. As a result of this inherent interest, the instructor will use naturally and easily illustrations and comparisons which he knows will be intelligible and vivid to his particular students. This means, supplemented by a personal knowledge of what each individual student gives

most thought to, indicates to the engineering student that the English teacher's interest is genuine. A college course in engineering is not necessary to furnish the instructor with general technical information. Indeed it is preferable that he should not have a specialized course, though a knowledge of higher mathematics,, of physics, and of chemistry is not to be despised. Yet if he has only a general knowledge of the sciences and a broad view of the technical course, he runs less danger of making a humanistic subject too highly specialized and too technical in its leaning—a fault which frequently arises from intensive technical training and the concomitant narrowing of range. For the effective teaching of a humanistic subject such as English, the medium of intercourse grows out of the technical interest of the students; the result, however, does not curtail, but broadens the general interests. Consequently, the final attitude of the student depends upon the personality of the instructor—his balance, his enthusiasm, his acquaintance with various phases of life and types of men, and his insight into the mind of the individual—far more than upon his knowledge of engineering.

Yet possessed of all these qualities, unaided, the English instructor can not hope to secure the best results. He must have the good-will, the sanction and the open coöperation of the faculty of the college of engineering. One has only to recall one or two of the characteristics of the engineer previously noted—his shrewdness, his practicability—to recognize and appreciate the aid that comes from hearty coöperation on the part of the engineering faculty. For, if the members of his own corps of instruction point out the value of such a subject as English, which appears to be totally unrelated to an undergraduate course in engineering; if the instructors of strictly technical subjects cite cases in which the possession or lack of English has had a far-reaching effect upon the outcome of some technical problems; if they manifest a pleasure in the best of the world's thought; and if they insist

upon intelligible and accurate expression of ideas, they carry conviction, break down a barrier and drive home the teaching of the rhetoric instructor, who even under the most favorable circumstances, is regarded as a somewhat prejudiced witness. The most successful teaching of English to engineering students, therefore, must always include as a part of its method the coöperation of the engineering faculty.

BACHELORS OF SCIENCE OR SKILL?

BY W. H. RAYNER,

Associate in Civil Engineering, University of Illinois.

There is good reason to believe that our schools of science and technology may well consider whether or not they are quite sincere or accurate in the labels they put on their product. On commencement day the graduate has conferred upon him a bachelor degree in some branch of engineering or of science; but if we look carefully into the training he has received there may be some question regarding his possession of the essential attributes of the engineer or scientist. A brief consideration of some of the implications involved here may be of some interest.

The word "engineer" from its very meaning of course refers to one possessed of such qualities as ingenuity, inventiveness, etc.; while the attributes of the scientist are also quite definite even though they cover a broader range of human activity. The scientific method in which both the engineer and scientist are supposed to be trained is quite a definite procedure and has been stated by John Dewey* as follows:

"In any given science we attempt to state our knowledge in such form that it will answer both of these requirements, so that we may test any given proposition by noting whether and how it follows from other propositions taken as established and also may utilize given propositions to arrive at others not previously known. The process of obtaining data (or evidence), of definition (or fixation of meaning), of generalization (or reduction to principles), and of classifications

* Monroe, "Educational Encyclopedia," under Scientific Method.

(or graded grouping) characteristic of any science, are the means taken to satisfy these requirements."

He then goes on to make the following significant comment: "What is taught as science is often nothing more than a peculiar or technical body of information (*q.v.*). Externally speaking, it is science. That is, at some time it was actually reached by processes of reflective inquiry conforming to the general canons just mentioned. Moreover, it is labeled science in the educational scheme. But in so far as the pupil is unaware of the processes of reflective thought which give the information its characteristic scientific status, it has no real right to the title of science, and in so far as he does not himself go through these processes and thereby take an active part in performing the specific logical processes that transform the body of facts and laws into a science, there is no genuine study of *science*. There is merely the acquisition of a certain bulk of externally communicated information, information which is, indeed, distinctive in its technical terminology, but which is for that very reason more remote from any actual thinking on his own part than acquired information of a more familiar sort."

In the light of these statements, let us look at our collegiate methods in science instruction. The usual method of procedure in many courses in science is made up of the following parts: (1) Assignments from a text; (2) references for collateral reading; (3) lectures; (4) laboratory practice; and (5) examinations, daily, weekly or term.

The function of each of these parts may be briefly characterized as follows: (1) The text gives in convenient form the main facts and principles to be covered; it describes the achievements of other men—often most ingenious and stimulating achievements but very little is said of the painstaking, patient, systematic procedure and resourcefulness contributing to the attainment of the results secured; (2) the collateral reading supplements the text; (3) the lectures may be

of two types; (*a*) demonstration lectures, where an experiment is performed before the class to illustrate some principle, or (*b*) outline lectures, where an organized body of facts is given to the class, which serves to amplify the students' reading and to give coherence to the course; (4) laboratory practice consists largely in using apparatus assigned, following specific directions from a laboratory manual to secure prescribed results, and usually followed by a written record and interpretation of the results achieved; (5) the examinations are used to test the students' comprehension of the facts and principles he is supposed to have mastered.

In its relation to the educative process, it is noted that this procedure gives excellent training in the ability to follow directions; to record and exhibit results neatly and concisely; it provides the student in a very efficient manner with a large body of facts and data; and it develops the students' powers of observation and deduction. It is, however, quite devoid of opportunity for training in the scientific method. There is little resourcefulness or initiative required in any of the steps mentioned above. The whole performance is carefully planned *for* the student, not *by* the student. He manipulates objects but does not devise methods, he learns many facts but discovers none by his own research.

The distinction is not a new one. There is no claim for novelty in this regard. Rousseau in speaking on this principle in Emile's education said: "Let him not learn science, let him invent it" (Emile, iii, 173). "Emile will never know optics. He will never have dissected insects; he will not have counted spots on the sun; he will know neither microscope nor telescope. Your learned pupils will deride him. They will not be far wrong; because before using these instruments I mean that he shall invent them, and you are right in believing that this will not be early" (Emile iii, 223).*

* Cited by J. P. Monroe, "The Educational Ideal," Boston, 1896, p. 166.

I suppose none would regard this as practicable procedure; each generation must not be given the task of reinventing all that has preceded, and yet there is in this proposal the germ of true education in science. This method would provide opportunity for the expression of the creative impulses in the individual which constitute the very breath of life to the scientist. This point receives support from Professor Henry Fairfield Osborn, in whose book on "Huxley and Education" we find on page 9 this sentence: "The lesson of Huxley's life and the result of my own experience is that productive thinking is the chief *means* as well as the chief *end* of education, and the natural evolution of education will be to develop this kind of thinking earlier and earlier in the life of the student."

It may be that the "project" method of instruction, which is spreading so rapidly at the present time, is in part a fulfillment of Professor Osborn's' prophecy. Prof. W. L. Upson, of Union College, who cites the above quotation, believes that we need a new conception in the matter of education in the sciences. In his courses in electrical engineering he endeavors to center his instruction about the laboratory rather than the classroom and encourages the students to "invent" as well as to "learn" new principles. He thinks that a little original work on the part of the student is worth much more than a few routine reports.*

So it may be that we are training artisans more than we are educating scientists and our degrees might better be given as bachelor of craftsmanship or bachelor of skill. It may be that our educational methods, born of necessity in handling large numbers of students, are wise and justifiable but there should be no delusions regarding the character of the results achieved. It may be good social policy and wisdom in economy of time in our schools to train a large number of persons who can do the routine assistance required in the professions rather than to attempt the more precarious and expensive

* See ENGINEERING EDUCATION, 8, 5, p. 192.

process of educating scientists. If so, then our present methods may be deemed passably satisfactory. On the other hand, if the purpose of our scientific schools is taken to include the education of true investigators and scientists who are to do their part in broadening our fields of knowledge then, if the above remarks have any significance, they imply the need of a very different educative process.

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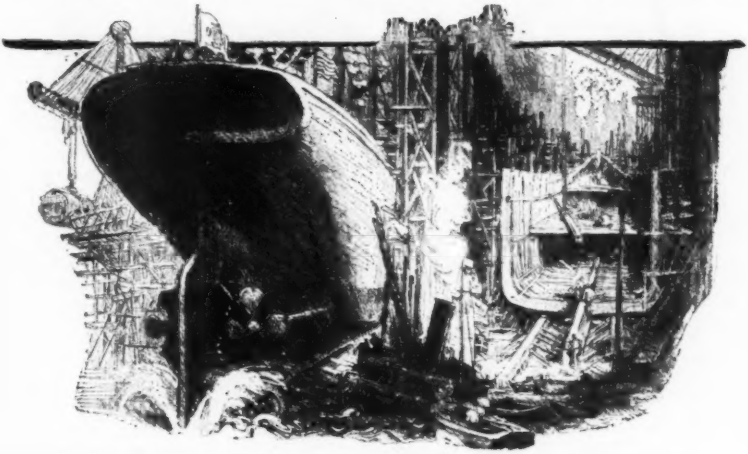

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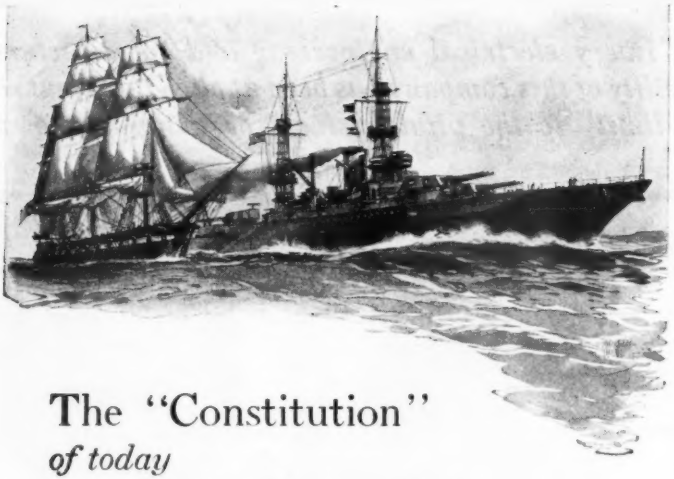

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